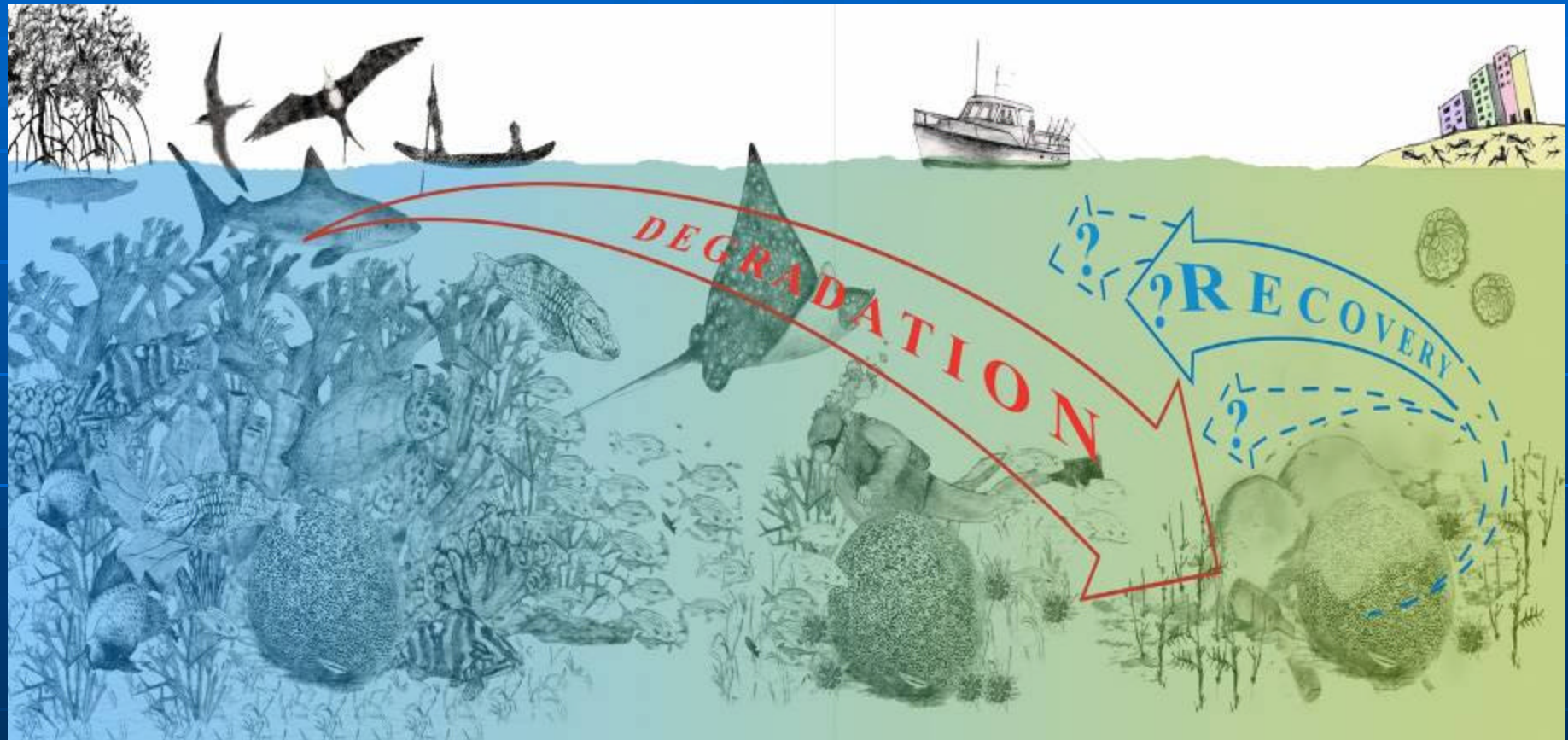


Ecosystem-Based Approaches to the Management of Coral Reefs

John Ogden, Director
Florida Institute of Oceanography
USF Professor of Biology

ENIWETAK ATOLL, MARSHALL ISLANDS

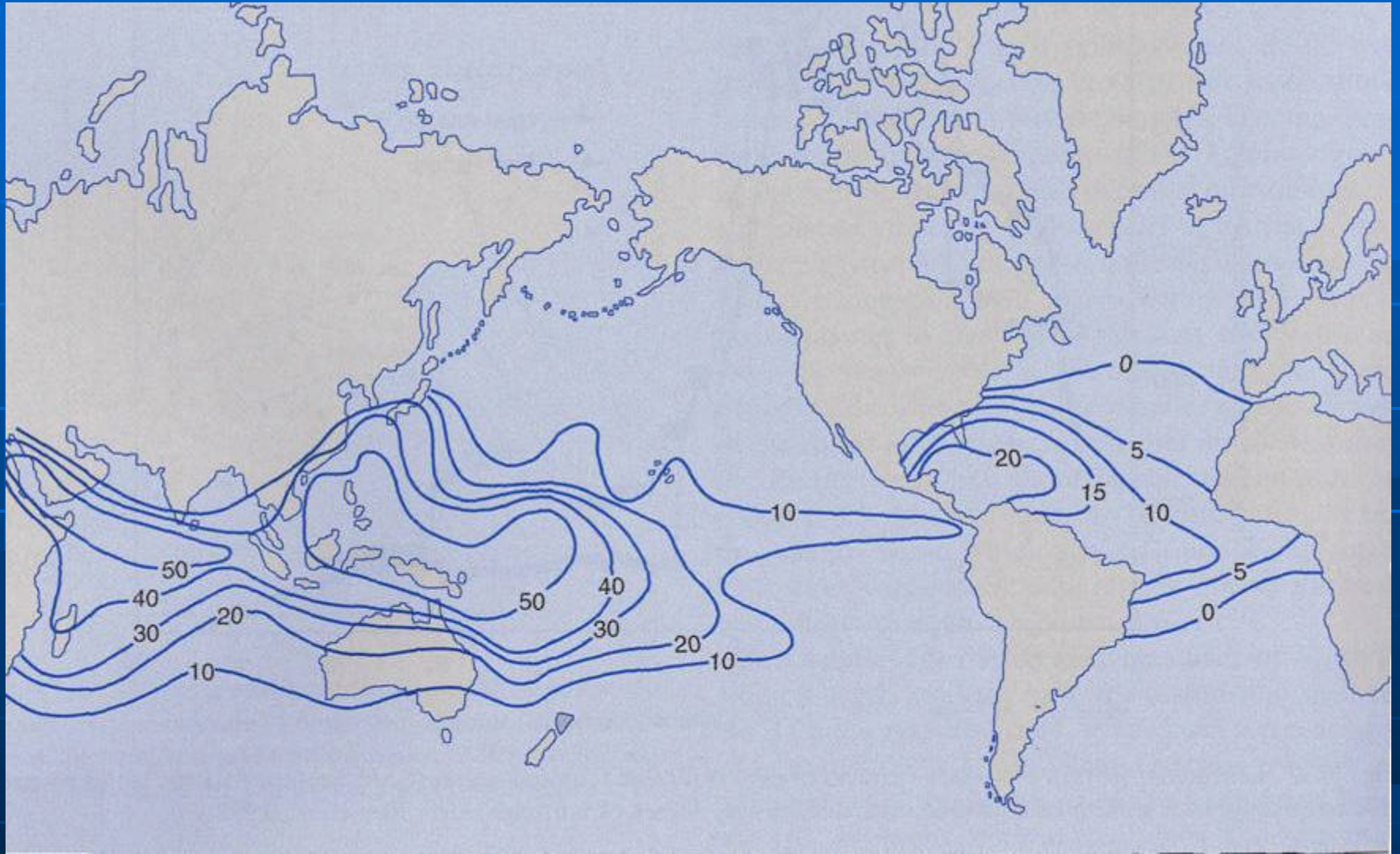
The Slippery Slope to Slime



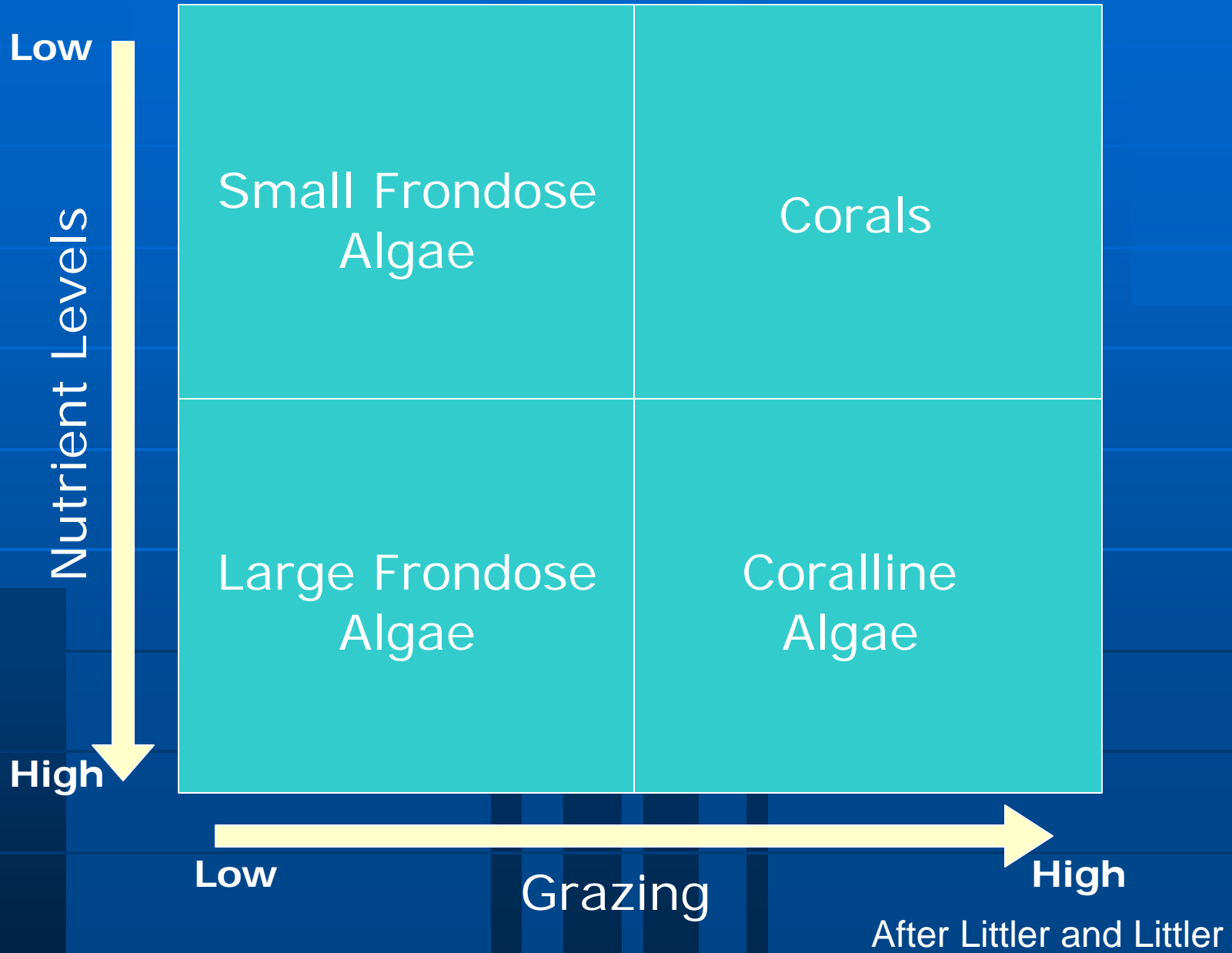
The Big Three

- Fishing
- Land-Based Pollution
- Global Climate Change

Coral Biogeography: Number of Genera



Conceptual Model of Grazing vs. Nutrients



Grazing: A Key Reef Process



Protect dead coral with a cage



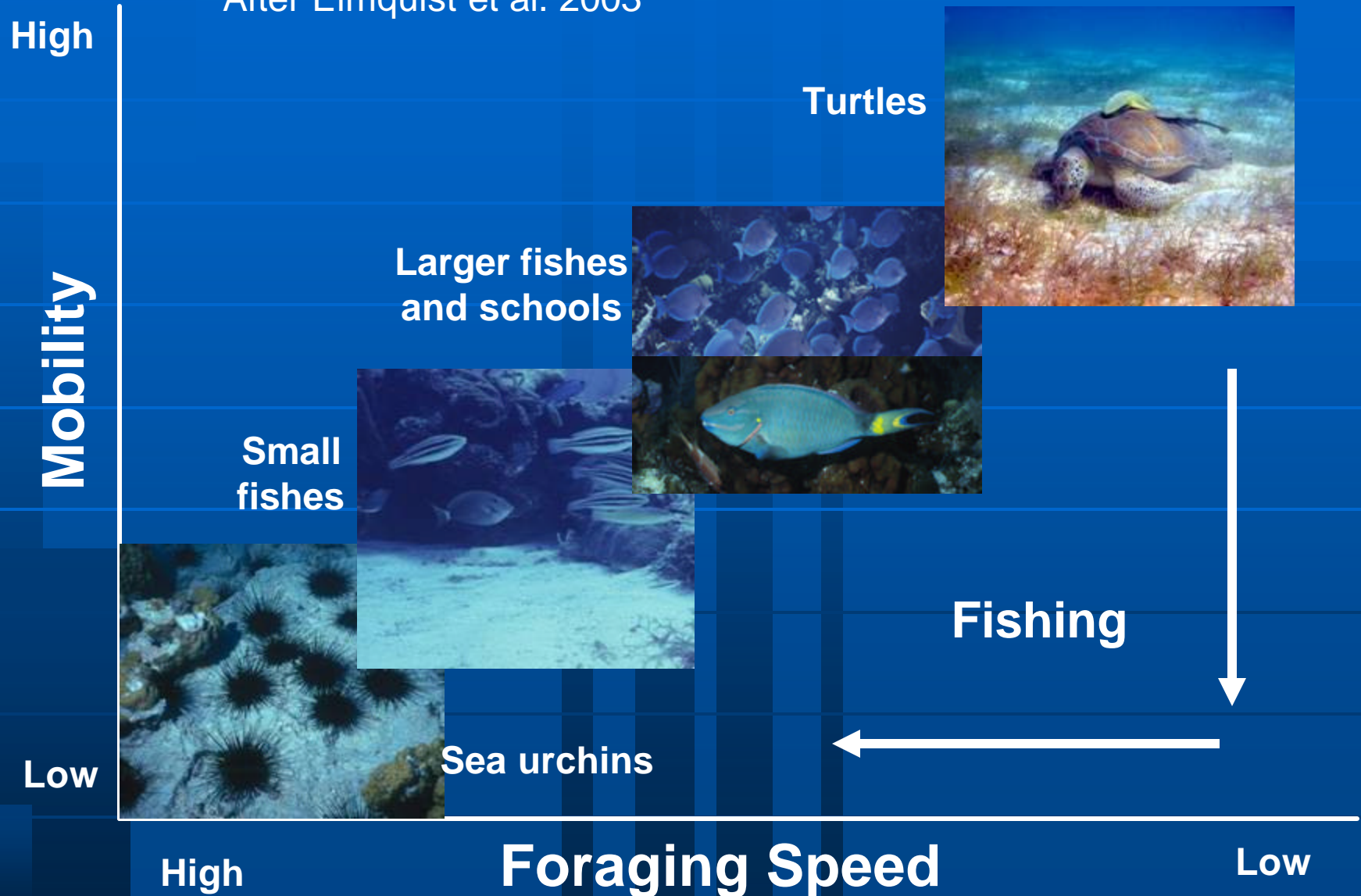
Within 2 weeks massive algal growth; coral pieces removed



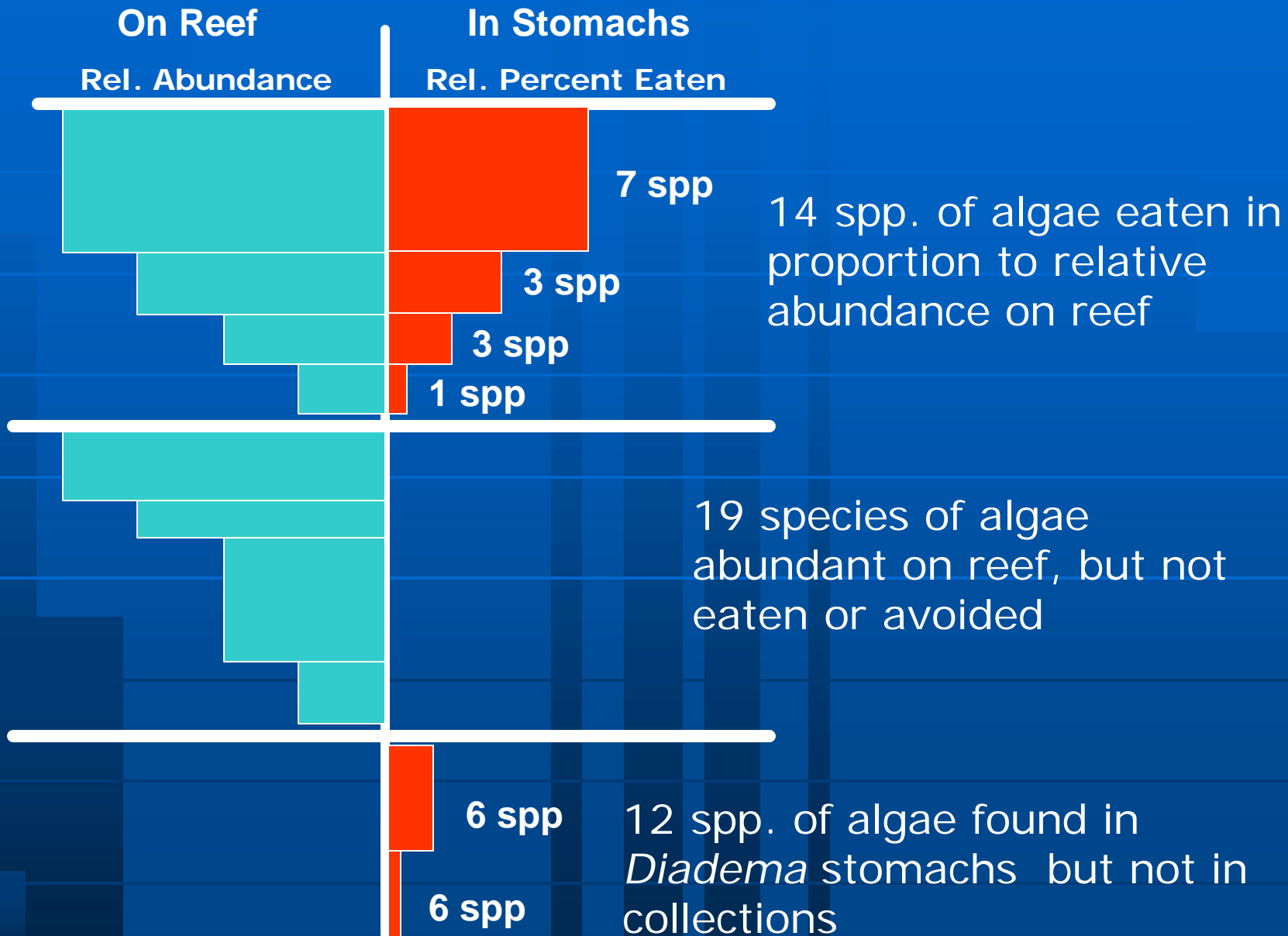
Algae removed by grazers from coral fragments in minutes

Diversity of Grazers Across Scales

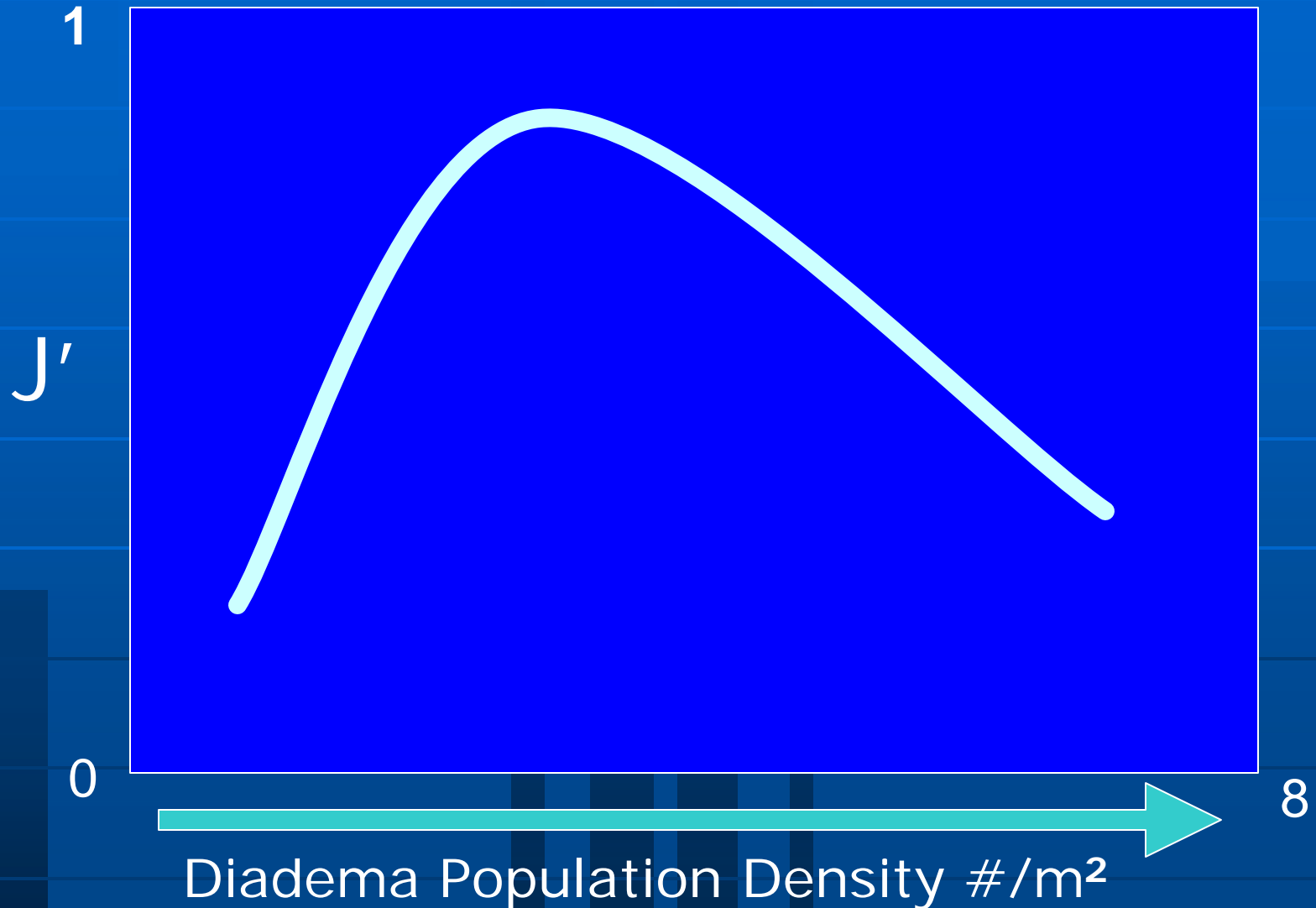
After Elmquist et al. 2003



Selective Foraging by *Diadema*



Diadema and Biodiversity of Algae



Sammarco, Levinton, and Ogden, 1974

Diadema Mass Mortality 1983-84



Sticky spines Day 1



Spines shed Day 4

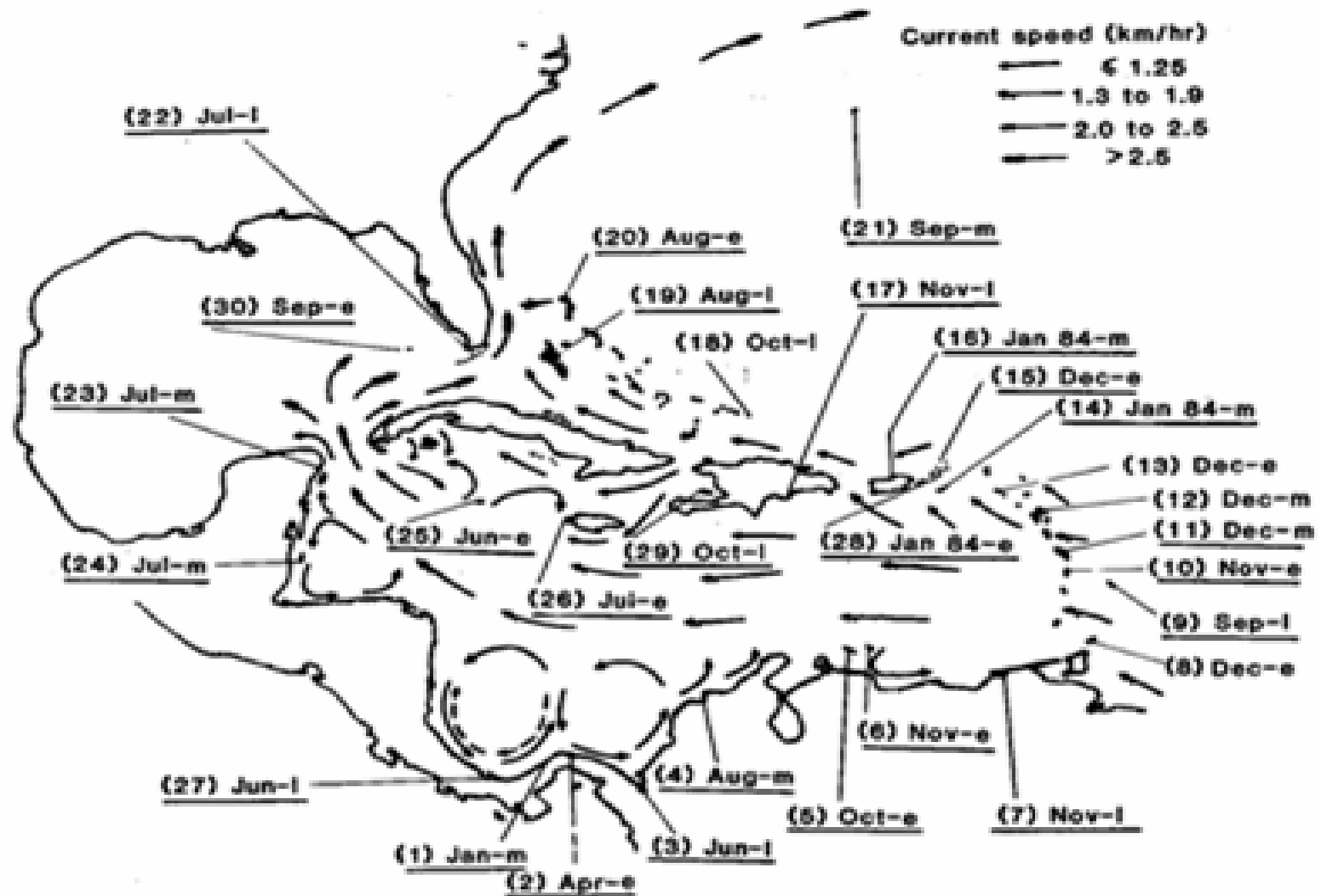


Death and predation Day 6



Recovering Day 12

Spread of *Diadema* Mortality



Post-Mortality St. Croix



Feb. 6, 1984



March 11, 1984

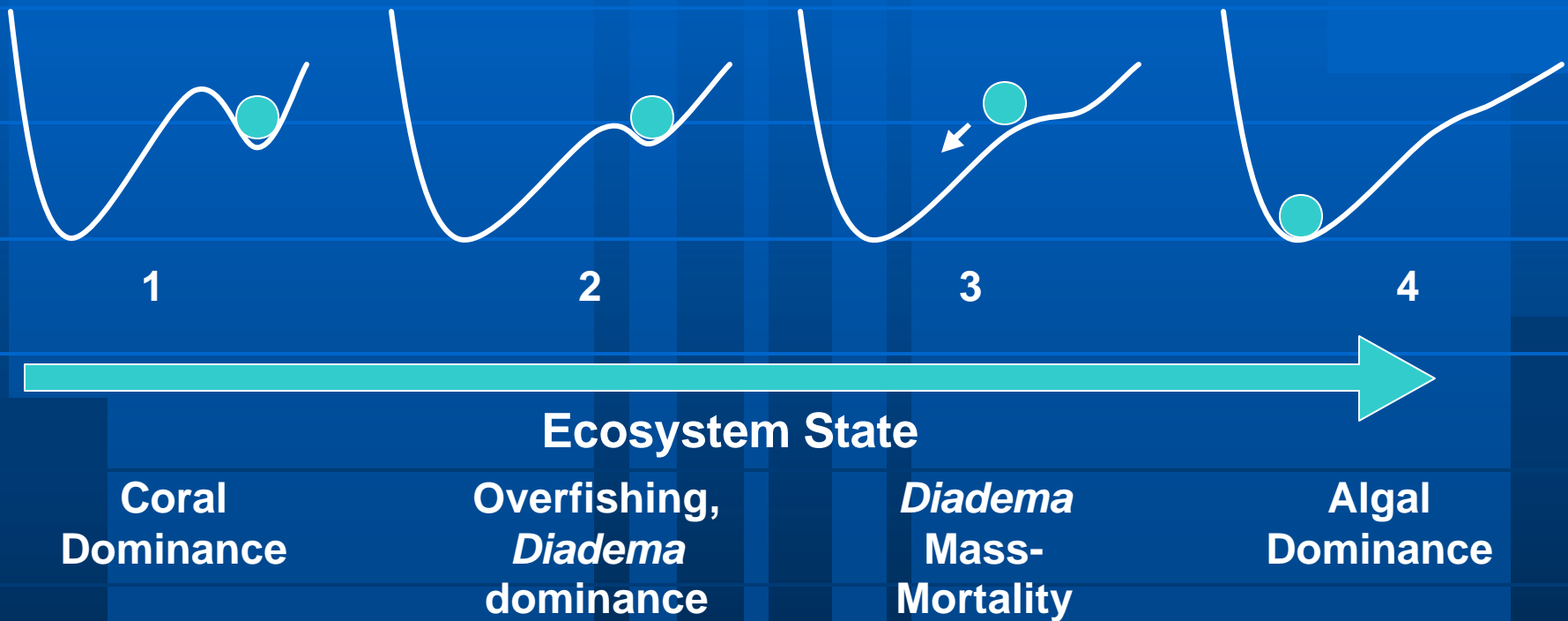


June 23, 1984



June 23, 1985

Resilience & Alternate States



Coral Anatomy



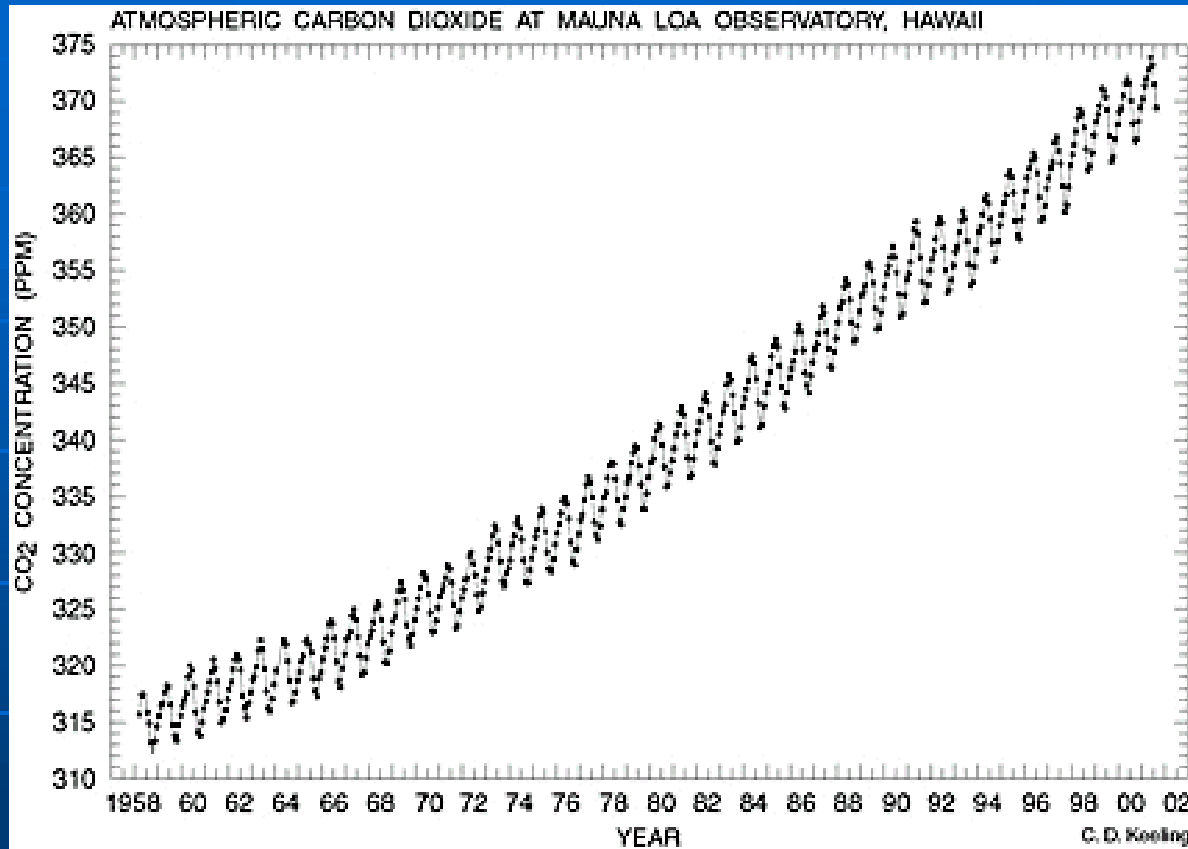
Symbiotic Algae



"Zoox"

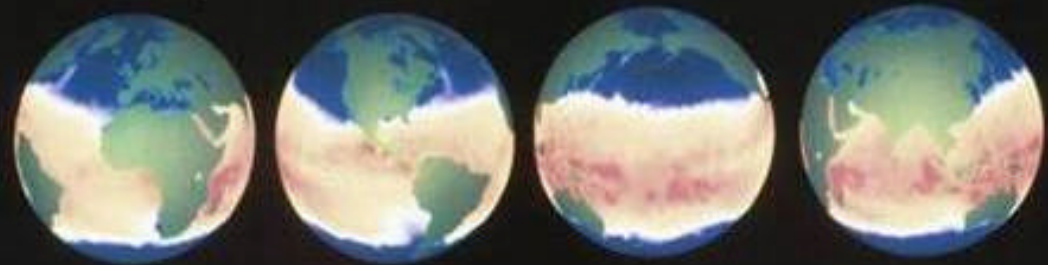
Zooxanthellae

Global Climate Change



Atmospheric
CO₂ ppm
1958-Present

1997-98 El Niño



Global Coral Bleaching



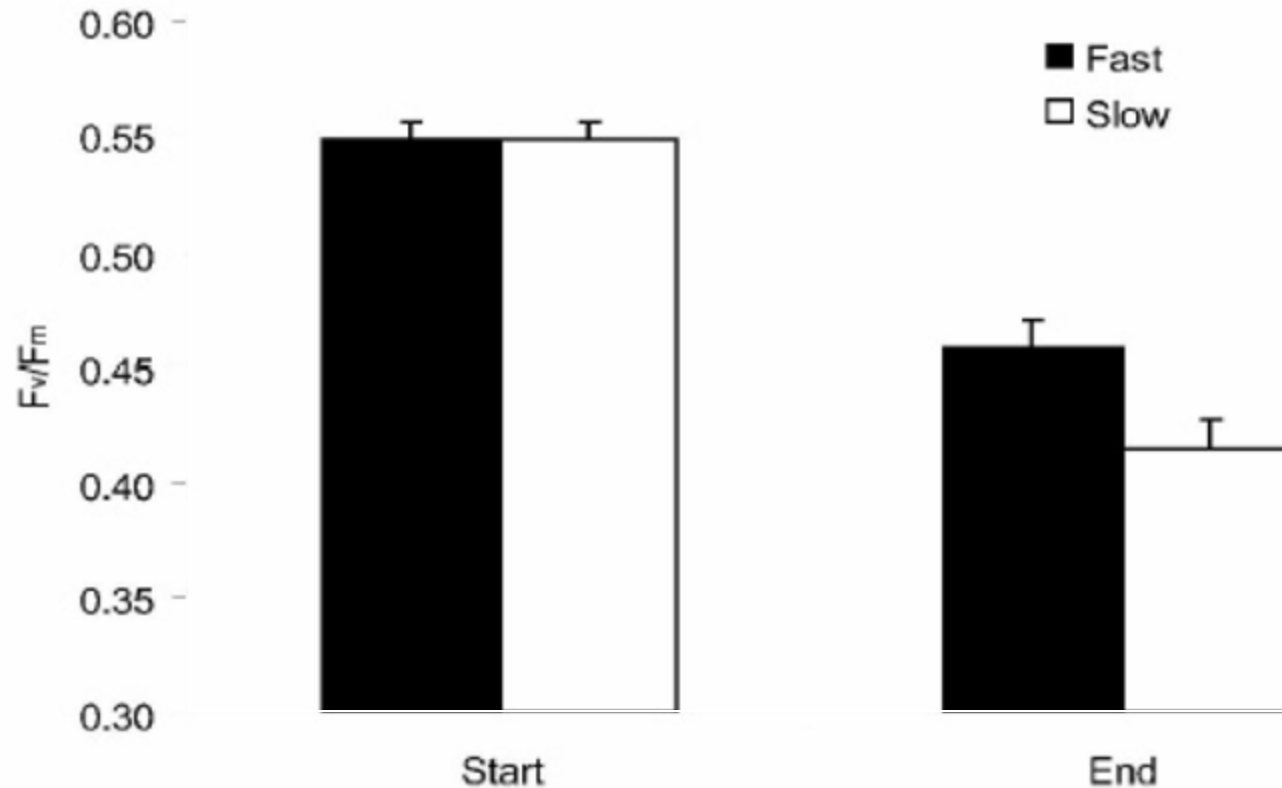
Florida Keys 1997-98

Phuket, Thailand 1997-98

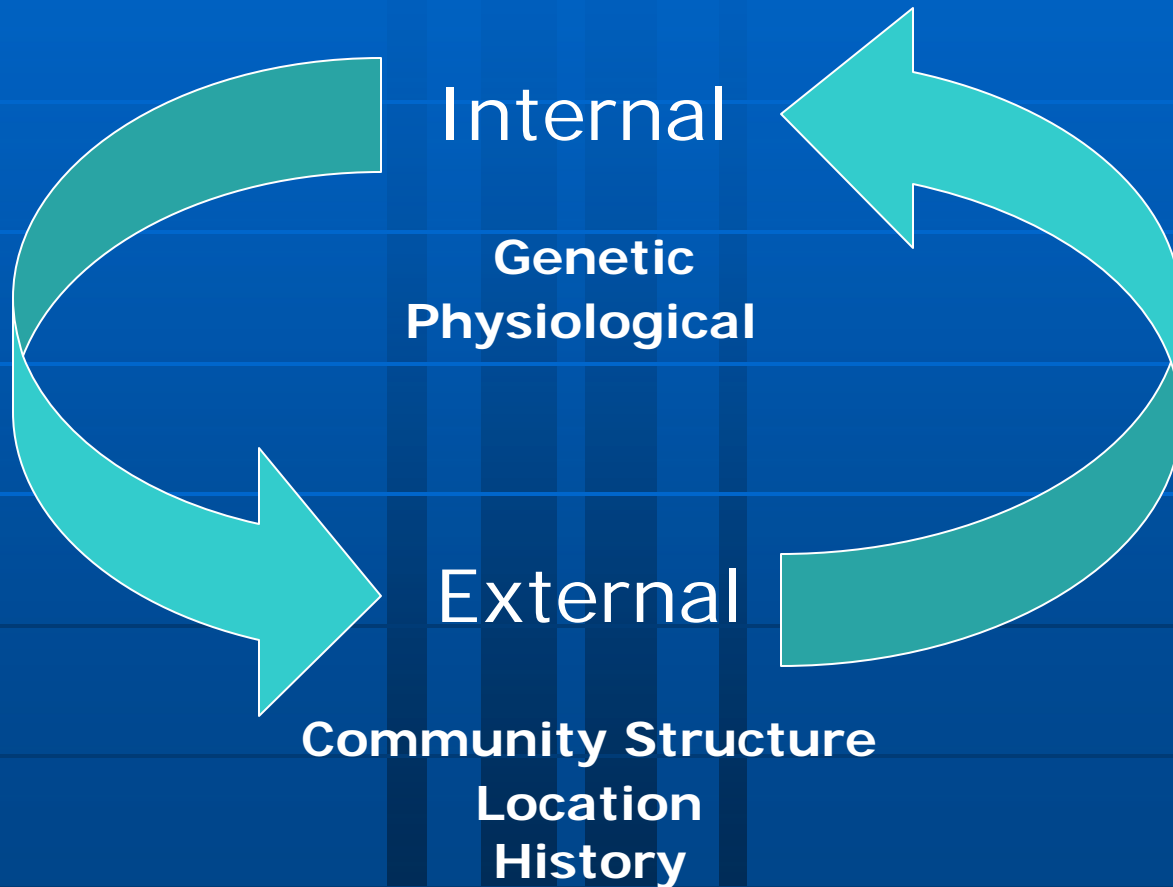


Effects of water motion on bleaching in the coral *Porites divaricata*

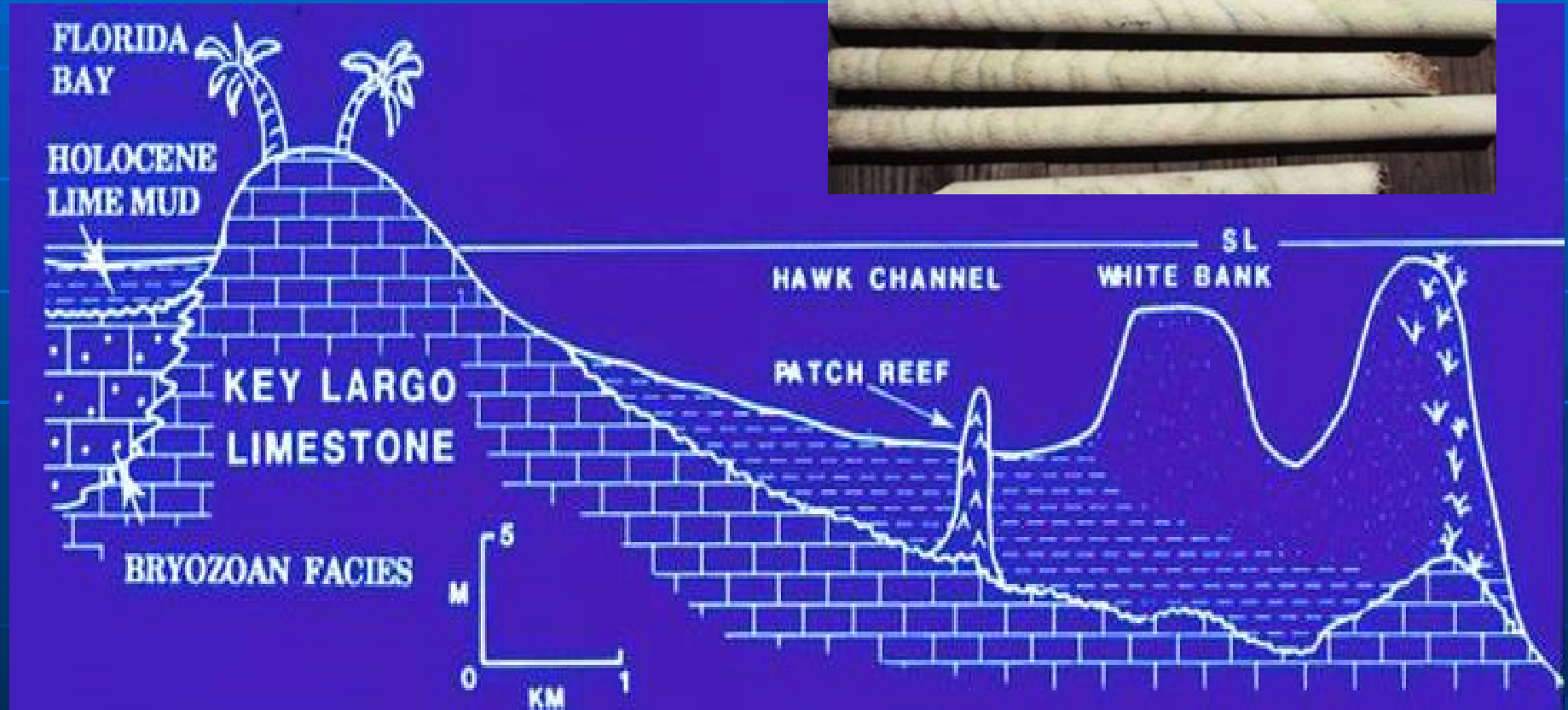
Seán Kinane – USF
in review, Coral Reefs



Coral Reef Resilience

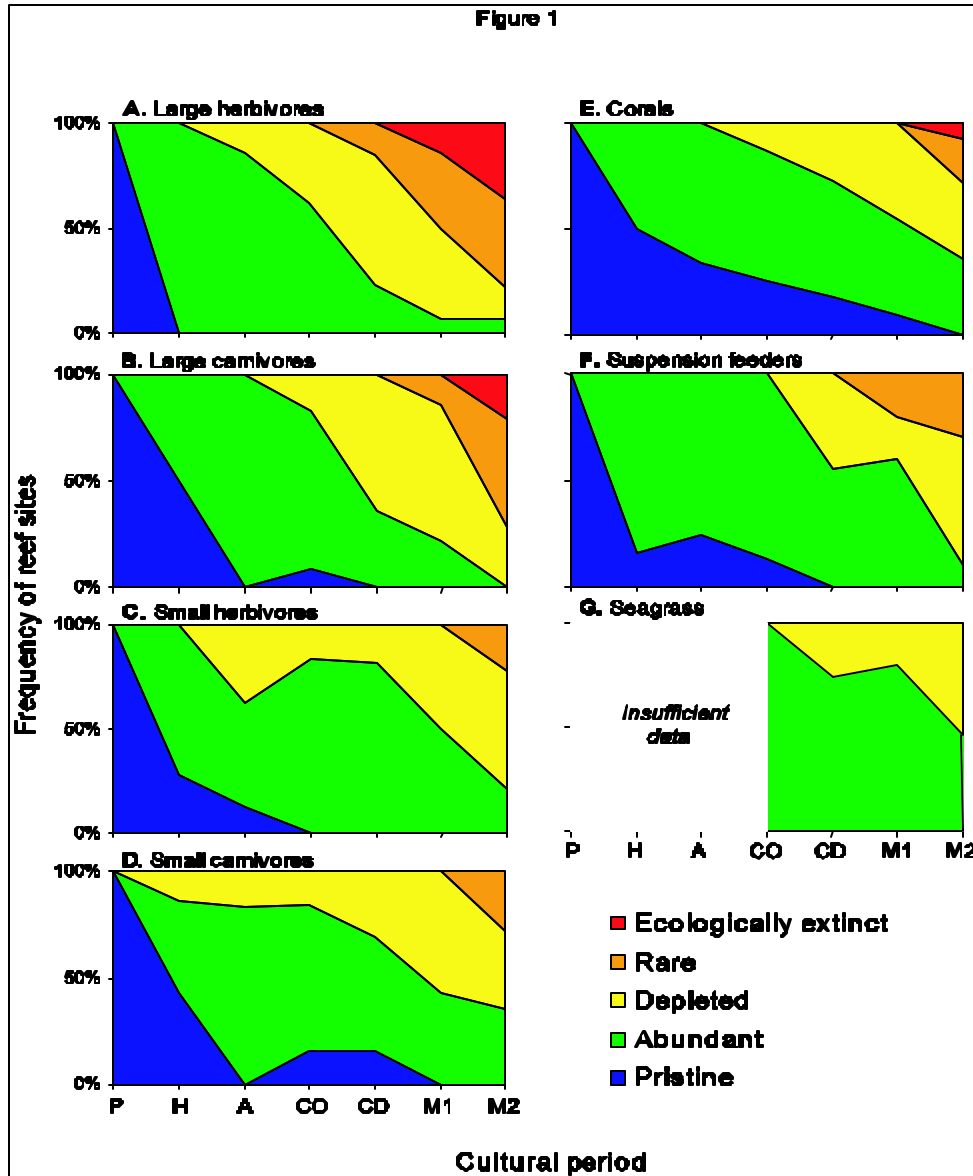


Coastal Reefs Holocene History



Courtesy E. Shinn

Historical Human Disturbances to Coral Reefs



CULTURAL PERIODS

P = Pre-human

H = Hunter-gatherer

A = Agricultural

CO = Colonial (early)

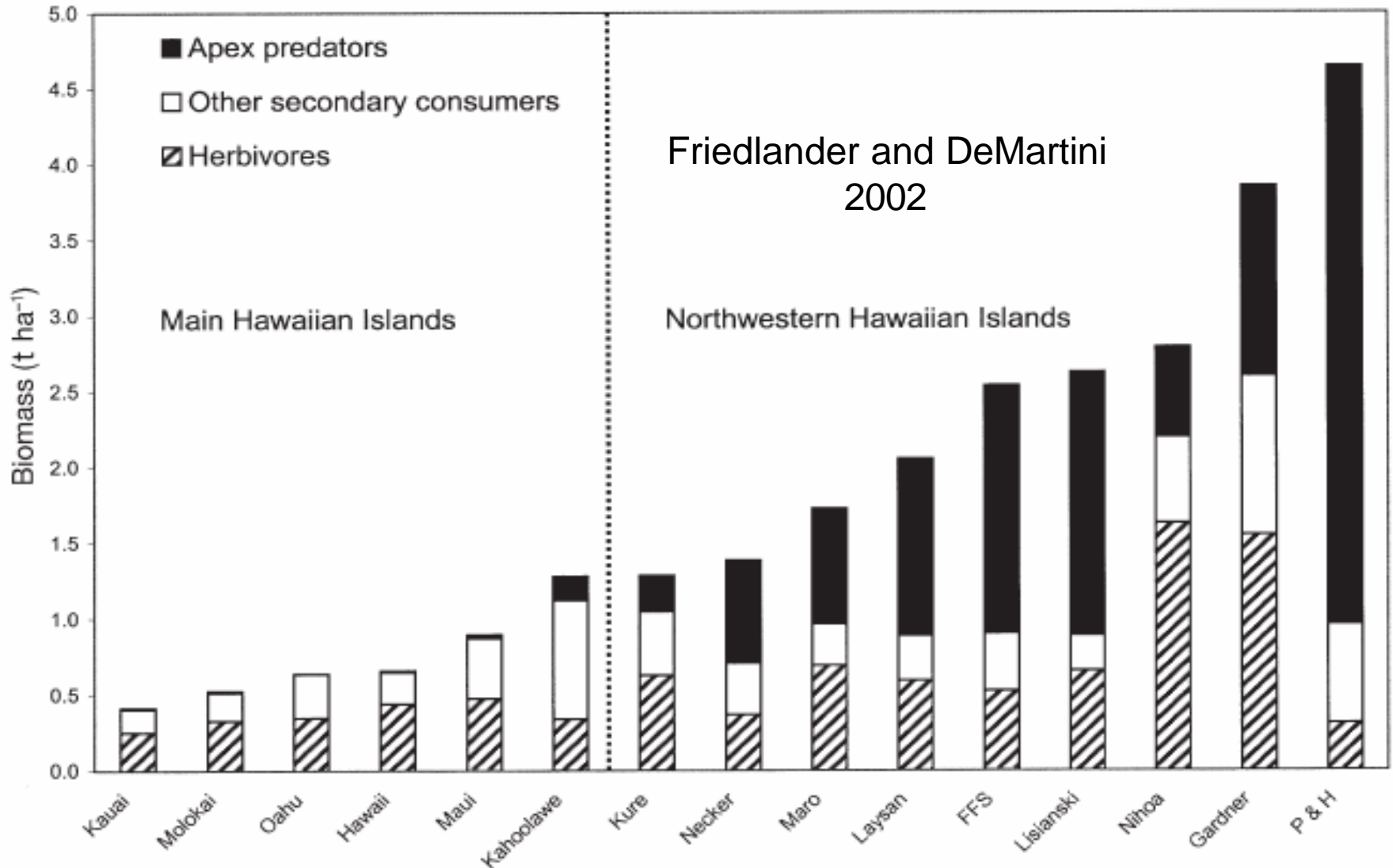
CD = Colonial devel.

M1 = Early Modern

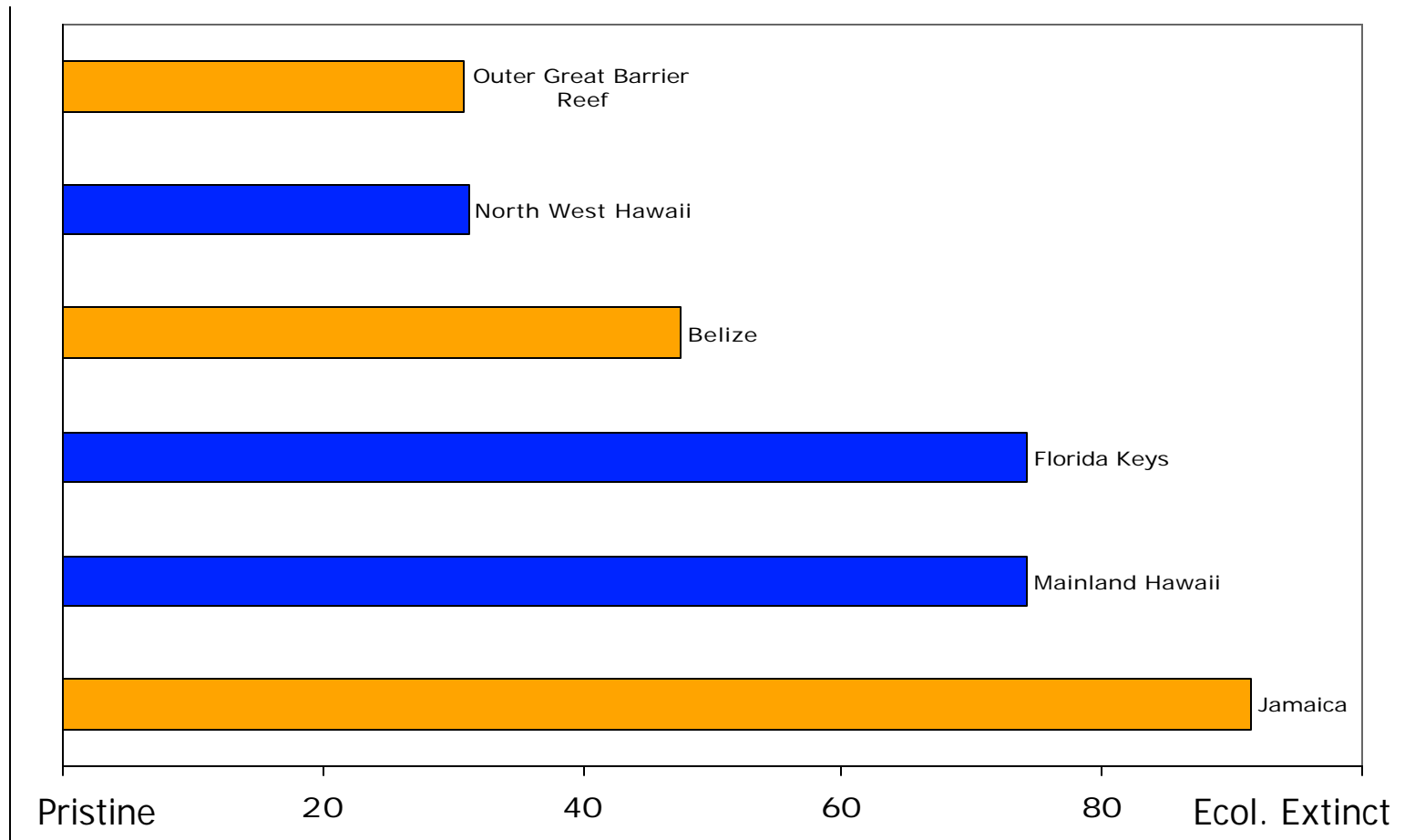
M2 = Late Modern to Present

From Pandolfi et al. 2003

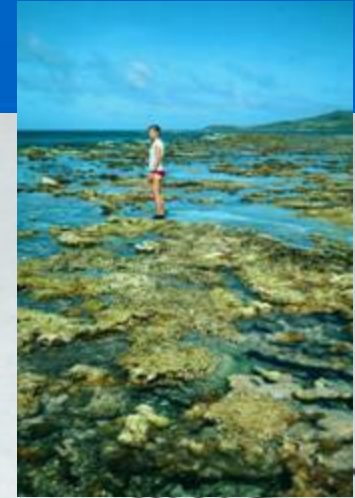
Fishing and Apex Predators



The Present Condition of Selected Coral Reefs, using Historical Ecology Methods from Pandolfi et al. (2003)



Reefs are Connected to Other Ecosystems and to the Land



Land

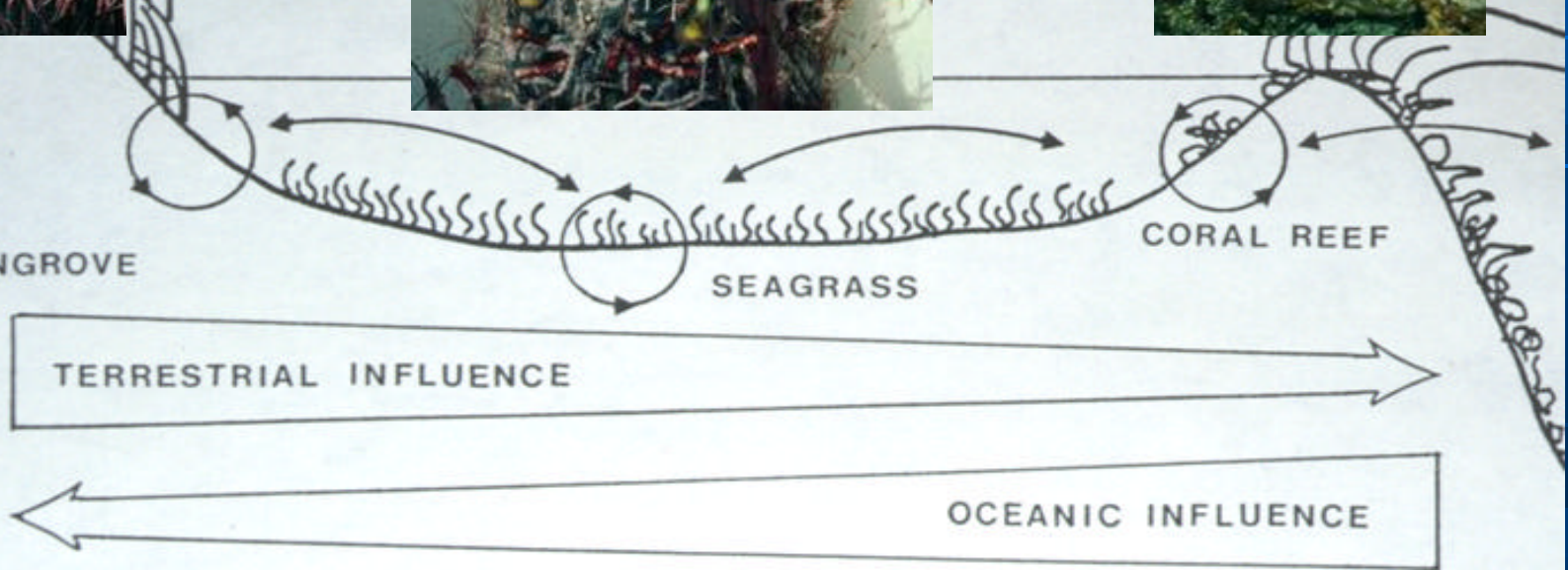
MANGROVE

SEAGRASS

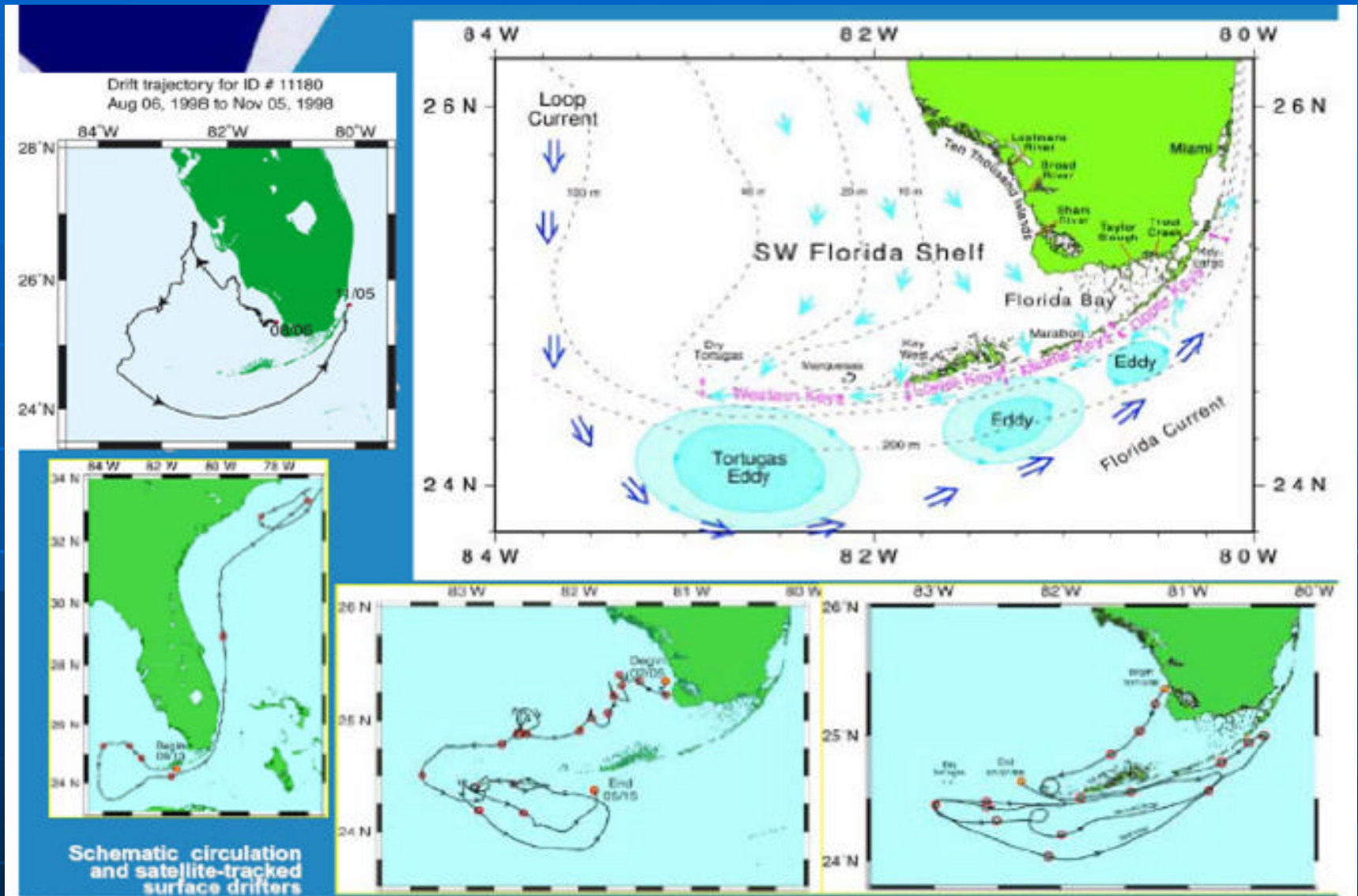
CORAL REEF

TERRESTRIAL INFLUENCE

OCEANIC INFLUENCE



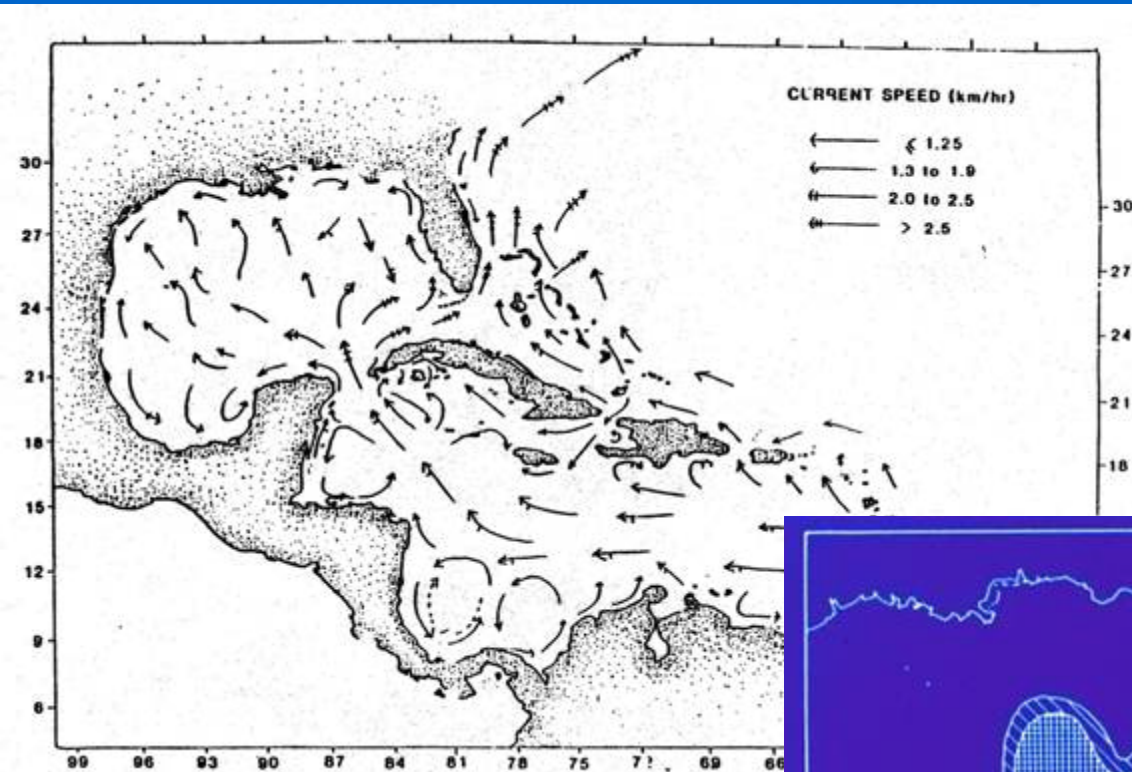
Schematic South Florida Circulation and Satellite Tracked Drifters



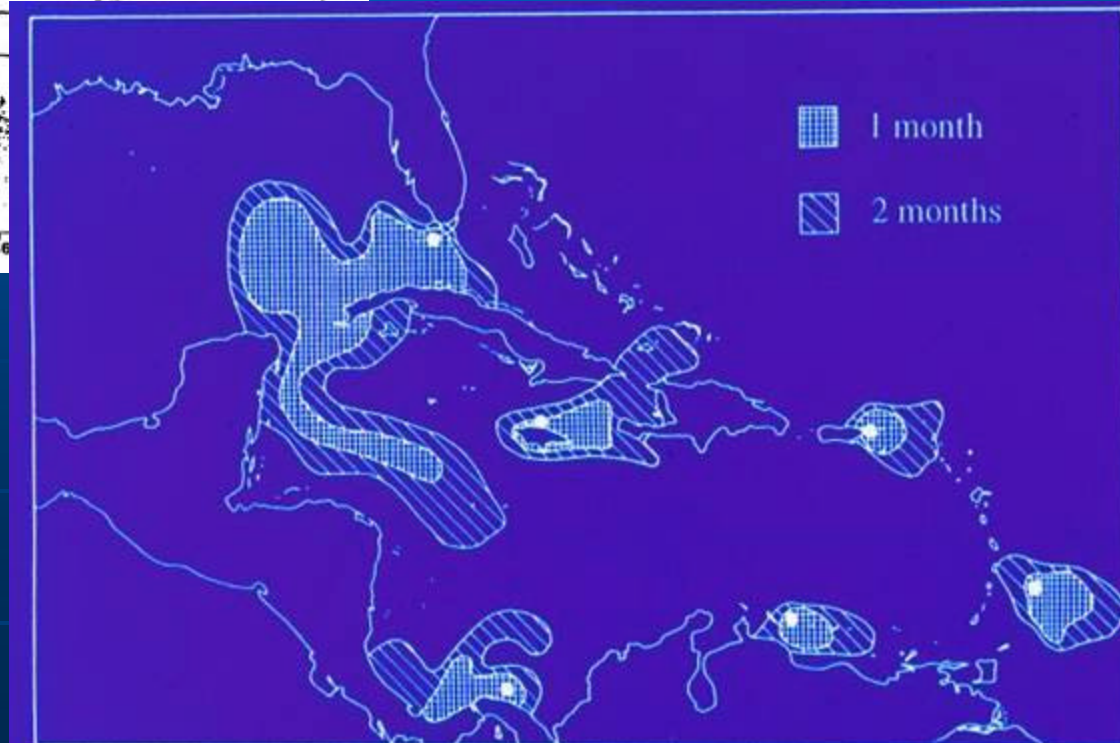
Courtesy V. Kourafalou RSMAS

Passive Larval Dispersal

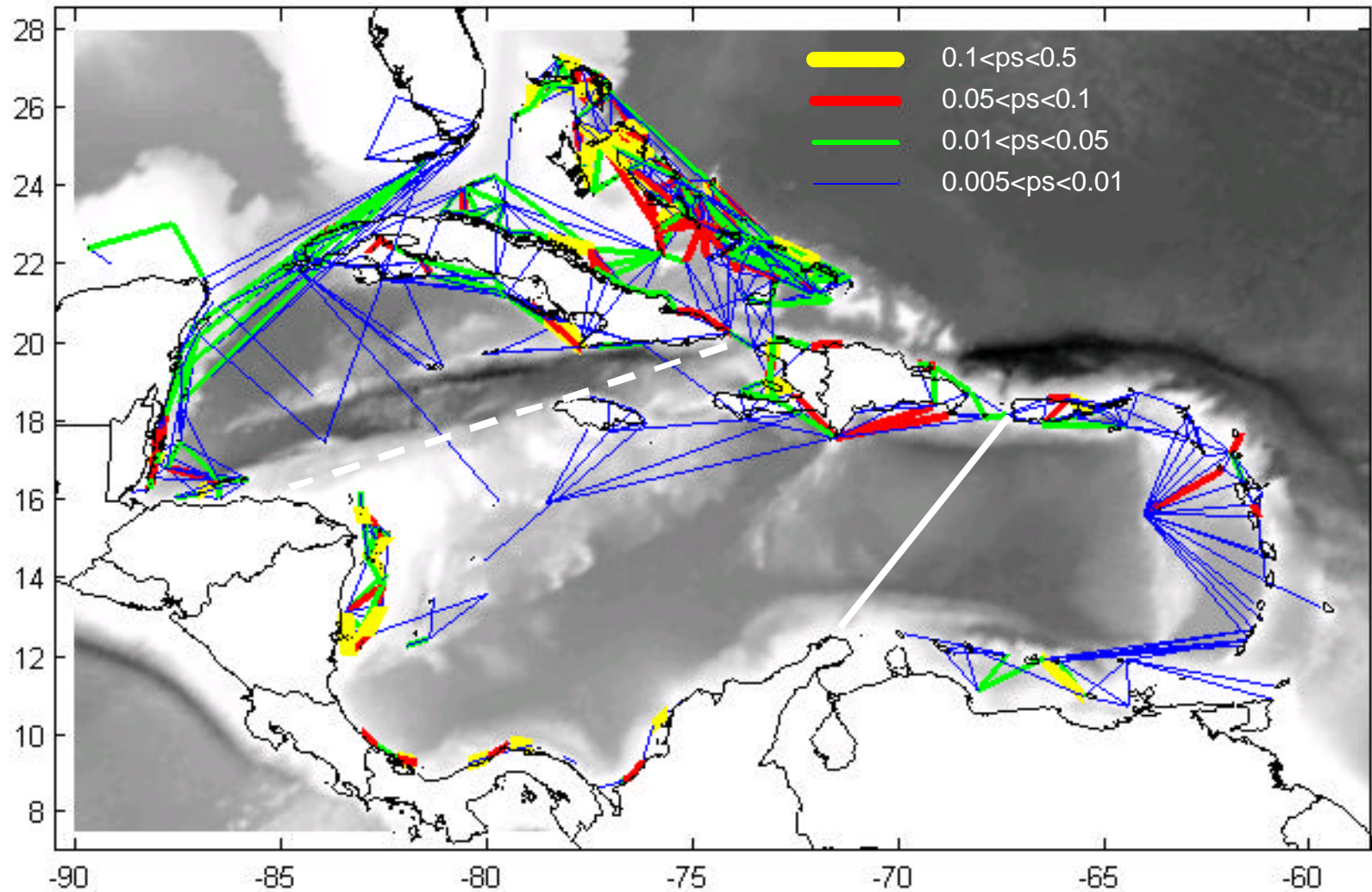
Surface Currents of the Caribbean



Larval transport envelopes based on larval lives of 1 and 2 months

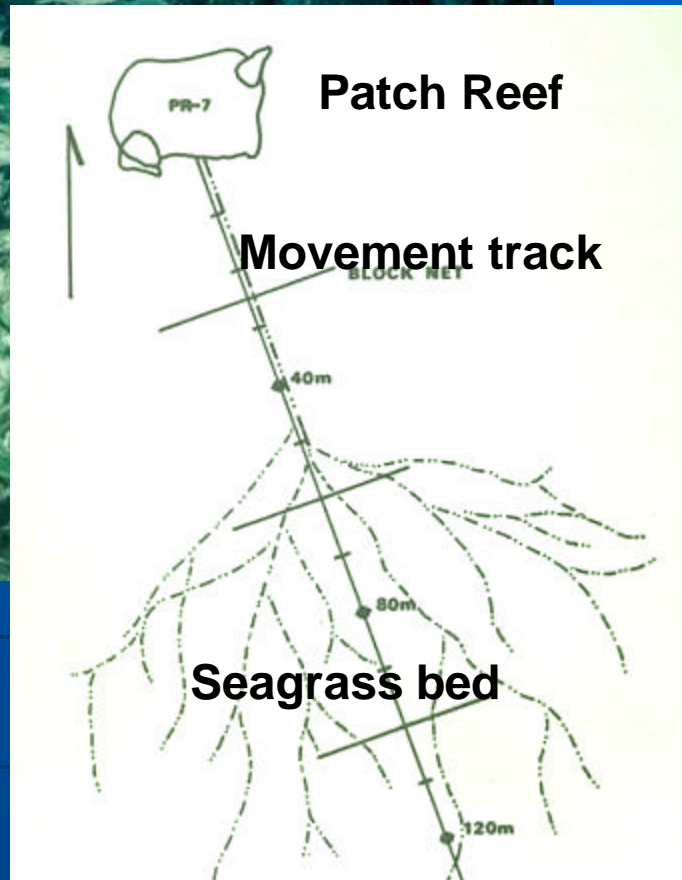
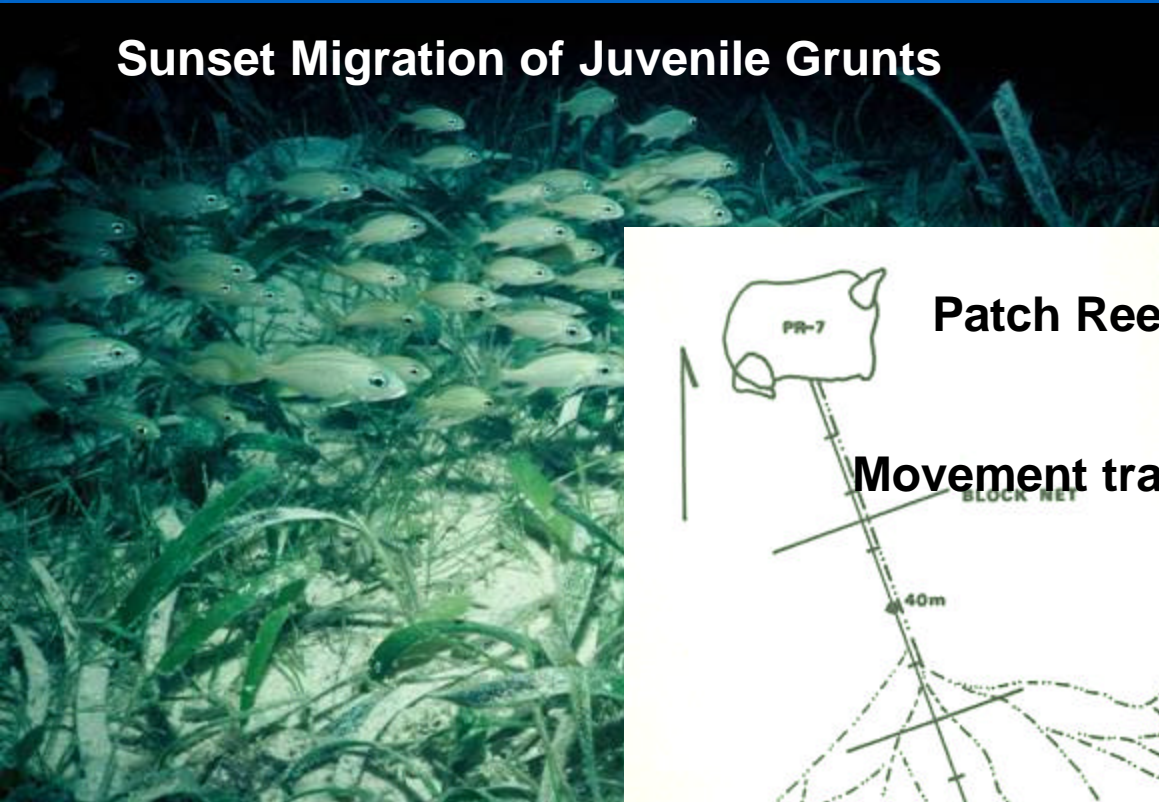


Connectivity Network for Reef Fish



Connectivity via Daily Movements

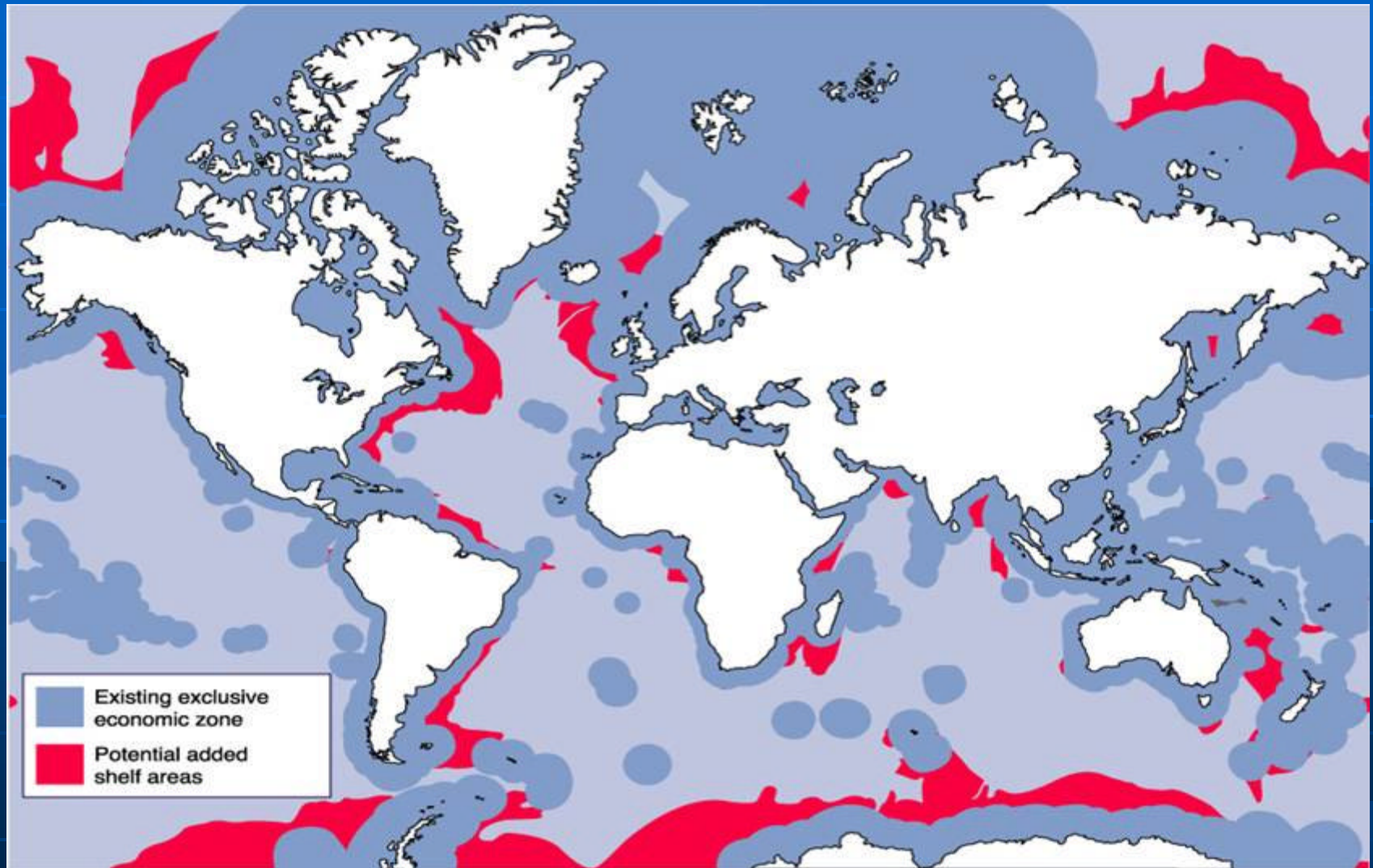
Sunset Migration of Juvenile Grunts



Daytime “Resting” Schools on Reefs



Exclusive Economic Zones with Shelf Extensions



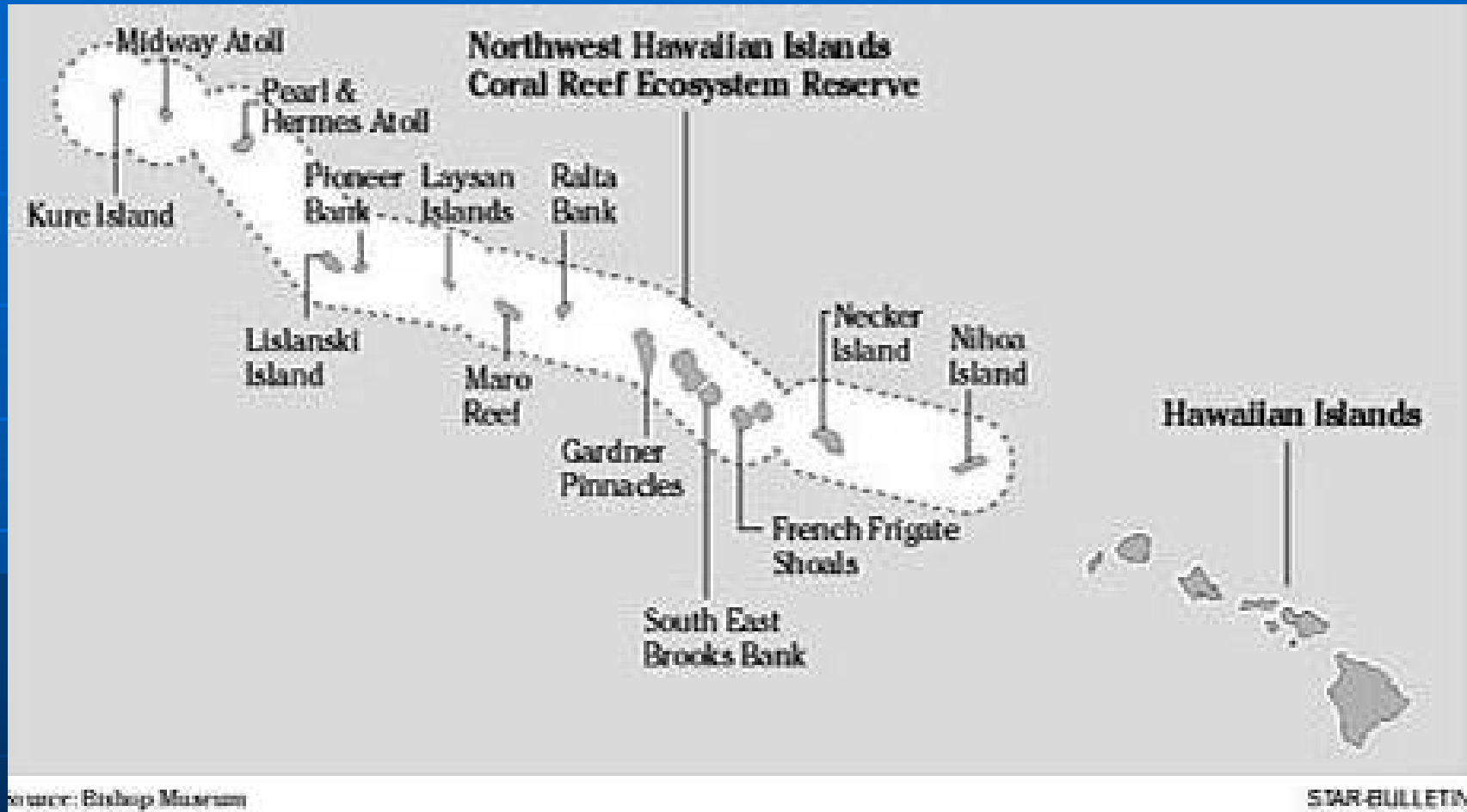
U.S. Large Marine Ecosystems

- Beaufort Sea
- Chukchi Sea
- E. Bering Sea
- Gulf of Alaska
- California Current
- Insular Pacific
- Gulf of Mexico
- Caribbean Sea
- S.E. Cont. Shelf
- N.E. Cont. Shelf

Ecosystem-Based Management

- Ecosystem Level Assessment & Planning
- Ocean-Use Planning
- Zoning
- Networks of Marine Reserves
- Adaptive Management
- Long-term Monitoring
- Research

A Place to Start?



Northwest Hawaiian Islands
Coral Reef Ecosystem Reserve

Visualization for EBM

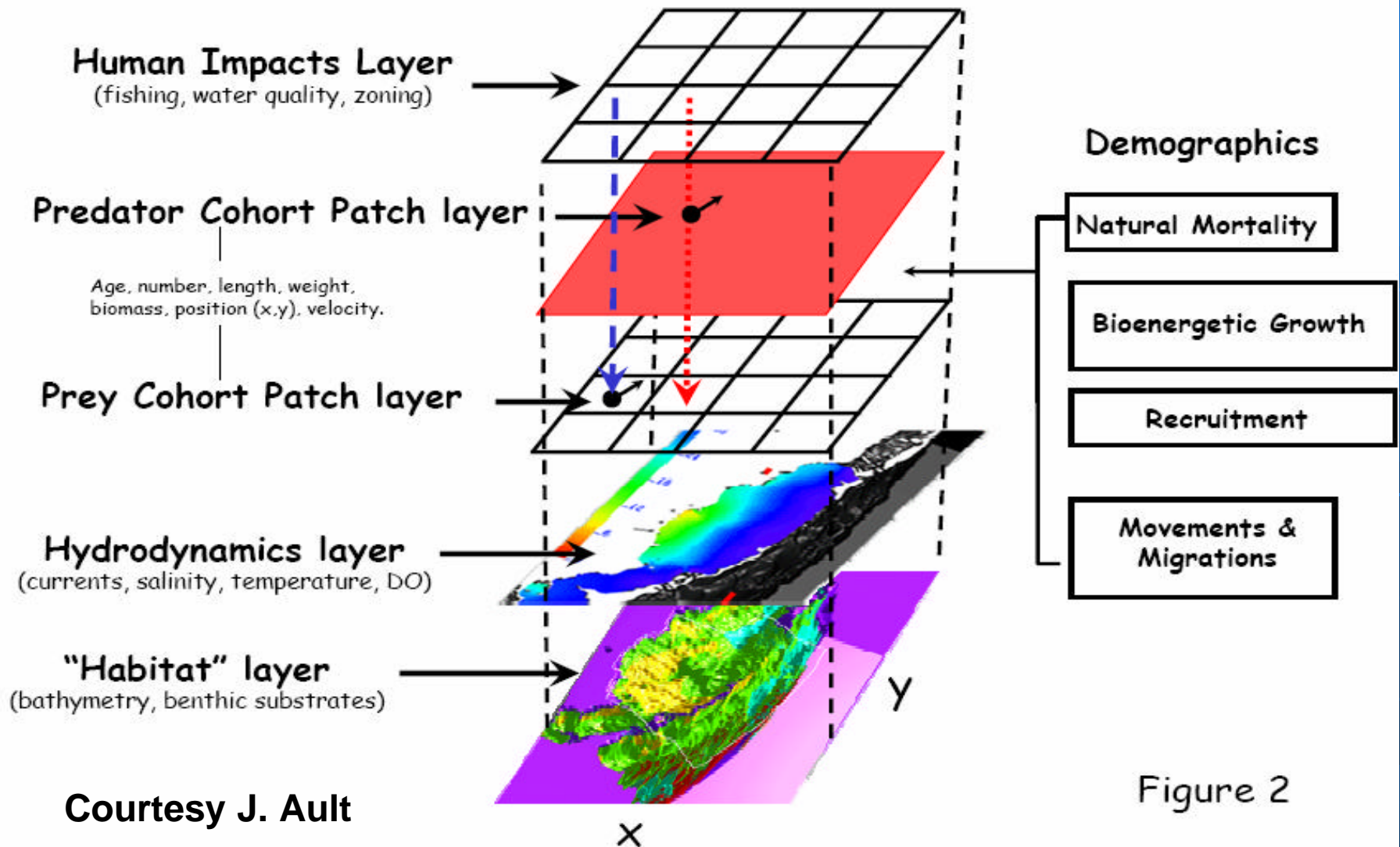
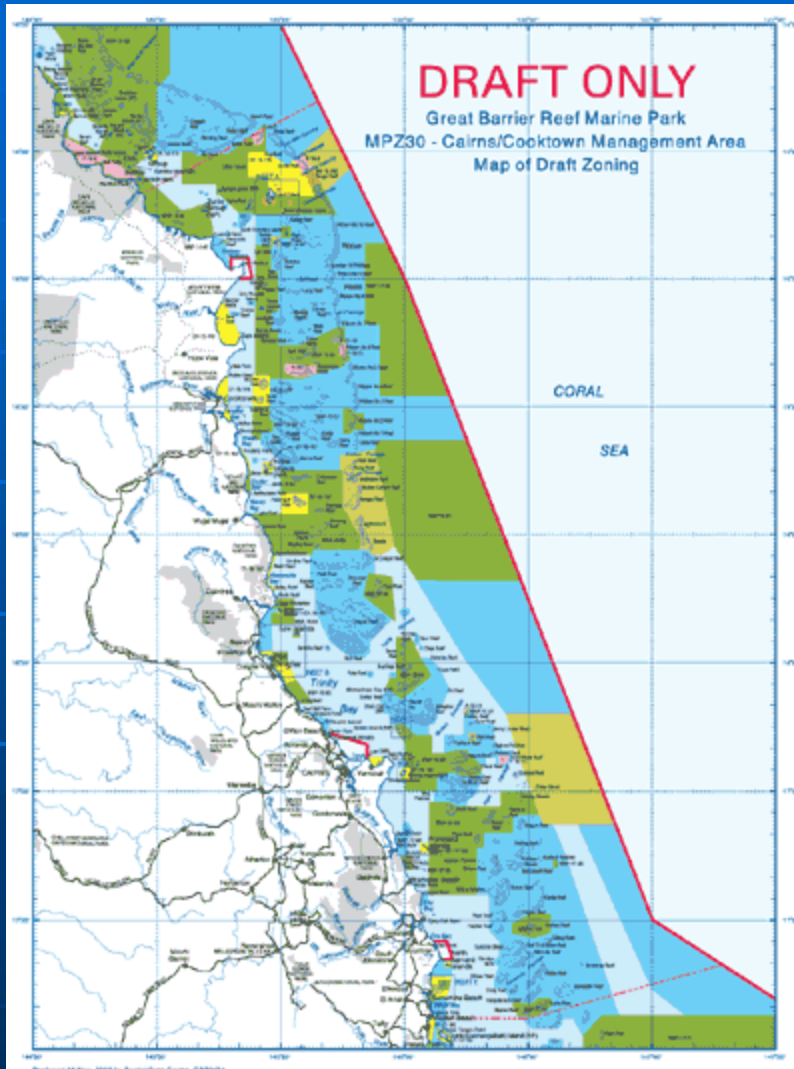








Figure 2

Zoning Scheme for the Cairns-Cooktown Section of the Great Barrier Reef Marine Park



MAJOR ZONES

-  Preservation Zone
-  Marine National Park Zone
-  Scientific Research Zone
-  Buffer Zone
-  Conservation Park Zone
-  Habitat Protection Zone
-  General Use Zone

What's Important About Zoning?

- It addresses the sea's heterogeneity
- It connects the sea to the land
- It dramatically reduces open-access competition
- *Sustainable use* is the central issue
- It provides the spatial context for conservation

Ecosystem-Based Management

